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(54) Microstrip collinear antenna

(57) The present invention provides a microstrip collinear antenna (20) having cable connector assembly means (30) and a collinear microstrip printed circuit board means (32). The cable connector assembly means (20) responds to a radio signal, for providing a cable connector assembly radio signal. The collinear microstrip printed circuit board means (32) responds to the cable connector assembly radio signal, for providing a collinear microstrip printed circuit board radio signal. The microstrip line collinear antenna (20) is constructed with a number of one half λ printed circuit board elements on both sides [34(a),34(b)] of a double-sided board (34). These one half λ sections are the radiators. On the other side of the board opposite each radiator [36,38,...,54;56,58,...,72] is a respective section of corresponding microstrip transmission lines [36(a),38(a),...,54(a);56(a),58(a),...,72(a)] to provide radio frequency power to each radiating element. The microstrip line collinear antenna (20) has the following advantages over the prior art antennas: it achieves shorter length due to close physical spacing of radiators, it maintains consistent pattern and impedance performance across the operating frequency range, it allows for accurate and consistent manufacturing through the use of advanced printed circuit board materials, allows for center feed design to achieve high-gain broadband operation, and it allows cost reduction with printed circuit board materials.

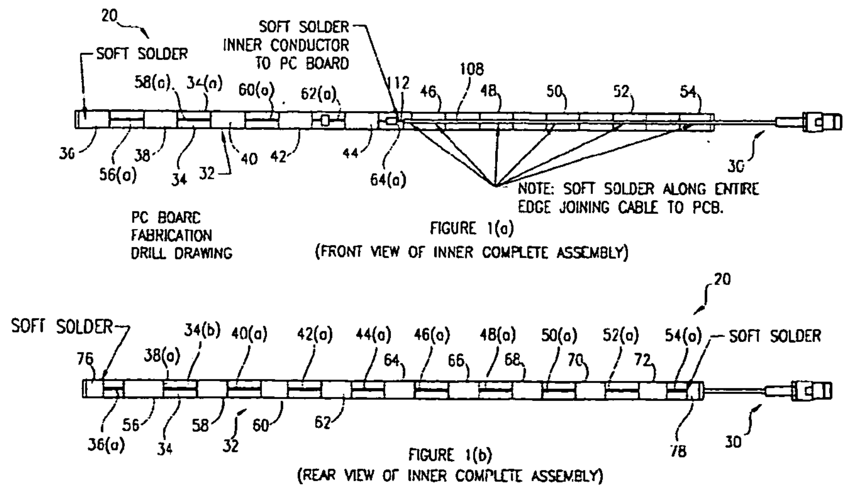


FIG. 1
(MICROSTRIP COLLINEAR ANTENNA)

Description

BACKGROUND OF THE INVENTION

Field Of The Invention

The present invention relates generally to antennas, and more particularly relates to a microstrip collinear antenna.

Description Of The Prior Art

Omnidirectional personal communication service (PCS) antennas are increasingly becoming important antennas in the cellular communication industry. Omnidirectional personal communication service (PCS) antennas are small, lightweight, easily affixed to buildings and other structures in and around cities and suburban communities, and more aesthetically pleasing when compared to the otherwise huge radio antenna towers that have been known in the cellular communication industry.

There are many known omnidirectional personal communication service (PCS) antennas in the prior art. In general, omnidirectional PCS antennas are constructed as sleeve dipoles or wire antennas with element spacings of .75 λ in order to achieve proper radiation patterns. A traditional collinear design would require transposed coaxial 1/2 λ element sections directly connected. In addition, these antennas have narrow patterns and impedance bandwidths.

In particular, United States Patent No. 3,031,668 shows in Figures 1-2 and describes a dielectric loaded collinear vertical dipole antenna having a sequence of coaxial cable sections 12-18, a 1/4 λ coaxial cable bottom section 11, a 1/4 λ coaxial cable bottom section 21, radially disposed conductive spokes 19, an antenna feed cable 20, and a signal translating circuit 50.

An IRE Convention Record, Volume 4, Part 1 (1956), entitled "A Vertical Antenna Made of Transposed Sections of Coaxial Cable", by H. Wheeler, shows in Figures 1(a)-(b) and describes a vertical antenna having a series of solid dielectric coaxial cables with inner and outer conductors transposed at every junction. Each section has an effective length of 1/2 λ in the solid dielectric coaxial cable, so the radiating gaps between the sections are all excited in the same polarity.

Cushcraft Corporation has a PCS antenna described in a readily available specification. The Cushcraft PCS antenna appears to be a 6 dB low profile omnidirectional antenna that operates in a frequency range of 1850-1990 Megahertz (Mhz), although the specification does not make clear the design thereof.

The prior art omnidirectional antennas suffer from a number of disadvantages, including having inconsistent pattern performance across their operating range as shown in Figures 16-18, requiring large element spacings and longer physical lengths, being difficult to assemble and labor intensive, and being very expensive and cost prohibitive.

SUMMARY OF THE INVENTION

The present invention provides a microstrip collinear antenna having cable connector assembly means and a collinear microstrip printed circuit board means.

The cable connector assembly means responds to a radio signal, for providing a cable connector assembly radio signal. The collinear microstrip printed circuit board means responds to the cable connector assembly radio signal, for providing a collinear microstrip printed circuit board radio signal.

In one embodiment, the microstrip line collinear antenna is constructed with a number of half λ printed circuit board elements on one side of a double-sided board. These half λ sections are the radiators. On the other side of the board opposite each radiator is a section of microstrip transmission lines to provide radio frequency power to each radiating element.

The microstrip line collinear antenna has the following advantages over the prior art antennas: it achieves shorter length due to close physical spacing of radiators, it maintains consistent pattern and impedance performance across the operating frequency range, it allows for accurate and consistent manufacturing through the use of advanced printed circuit board materials, allows for center feed design to achieve high-gain broadband operation, and it allows cost reduction with printed circuit board materials.

Other advantages will become apparent to those skilled in the art from the following detailed description read in conjunction with the appended claims and drawings attached hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings, not drawn to scale, include:

Figure 1 shows a diagram of a microstrip collinear antenna which is the subject matter of the present application, including respectively in Figures 1(a)-(b) a front and rear view of an inner complete assembly thereof of the microstrip collinear antenna.

Figure 2 includes Figure 2(a) which are a diagram of a PC board fabrication drill drawing of the microstrip collinear antenna shown in Figure 1, and includes Figure 2(b) which is an enlargement of an end radiating element of the PC board fabrication drill drawing shown in Figure 2(a).

Figure 3 is a diagram of a cable connector assembly of the microstrip collinear antenna shown in Figure 1.

Figure 4 includes Figures 4(a)-(e) which are diagrams of parts of a connector of the cable connector assembly shown in Figure 3.

Figure 5 is a diagram of a cable adapter subassembly of the microstrip collinear antenna shown in Figure 1.

Figure 6 includes Figures 6(a)-(d) which are dia-

grams of an outer conductor adapter of the cable adapter subassembly shown in Figure 5. Figure 6(d) shows a cross-section of the outer conductor adaptor body 106 along lines Z-Z'.

Figure 7 is a diagram of a cable stripping of the cable adapter subassembly shown in Figure 5.

Figure 8 is a diagram of a potting assembly of the microstrip collinear antenna shown in Figure 1.

Figure 9 includes Figures 9(a)-(b) which are diagrams of a support of the potting assembly shown in Figure 8.

Figure 10 is a diagram of a complete assembly of the microstrip collinear antenna shown in Figure 1.

Figure 11 includes Figures 11(a)-(b) which are diagrams of a radome of the complete assembly shown in Figure 10.

Figure 12 includes Figures 12(a)-(b) which are diagrams of a radome top cap of the complete assembly shown in Figure 10.

Figure 13 is a polar dB plot at a frequency of 1.990 Gigahertz of the complete assembly shown in Figure 10.

Figure 14 is a polar dB plot at a frequency of 1.920 Gigahertz of the complete assembly shown in Figure 10.

Figure 15 is a polar dB plot at a frequency of 1.850 Gigahertz of the complete assembly shown in Figure 10.

Figure 16 is a polar dB plot at a frequency of 1.990 Gigahertz of a prior art PCS antenna.

Figure 17 is a polar dB plot at a frequency of 1.920 Gigahertz of the prior art PCS antenna.

Figure 18 is a polar dB plot at a frequency of 1.850 Gigahertz of the prior art PCS antenna.

BEST MODE FOR CARRYING OUT THE INVENTION

Figures 1, 1(a) and 1(b) show a diagram of a microstrip collinear antenna generally indicated as 20.

The microstrip collinear antenna 20 comprises cable connector assembly means generally indicated as 30 and a collinear microstrip printed circuit board means generally indicated as 32. The cable connector assembly means 30 responds to a radio signal, for providing a cable connector assembly radio signal. The collinear microstrip printed circuit board means 32 responds to the cable connector assembly radio signal, for providing a collinear microstrip printed circuit board radio signal. As shown, the microstrip collinear antenna 20 has the decoupling spacing of 2.328 inches and chosen to limit undesirable current flowing between the coaxial cable (not shown) and the collinear microstrip printed circuit board means 32. The collinear microstrip printed circuit board means 32 has a double-sided circuit board generally indicated as 34 having a front side 34(a) and a rear side 34(b). The collinear microstrip printed circuit board means 32 has a first plurality of one half λ printed circuit board radiating elements 36, 38, 40, 42, 44, 46, 48, 50, 52, 54 collinearly arranged on one side 34(a) of the double-sided board 34. The collinear microstrip printed circuit board means 32 also has a respective section of microstrip transmission lines referred to as 36 (a), 38(a), 40 (a), 42(a), 44(a), 46(a), 48(a), 50(a), 52 (a), 54(a) arranged on the other side of the double-sided board opposite each corresponding one half λ printed circuit board radiating element 36, 38, 40, 42, 44, 46, 48, 50, 52, 54. The collinear microstrip printed circuit board means 32 has a second plurality of one half λ printed circuit board radiating elements 56, 58, 60, 62, 64, 66, 68, 70, 72, 74 collinearly arranged on one side 34(b) of the double-sided board 34, and has a respective section of microstrip transmission lines referred to in Figures 2(a) as 56(a), 58(a), 60 (a), 62(a), 64(a), 66(a), 68(a), 70(a), 72(a), 74(a) arranged on the other side 34 (b) of the double-sided board 34 opposite each corresponding one half λ printed circuit board radiating element 56, 58, 60, 62, 64, 66, 68, 70, 72, 74. The collinear microstrip printed circuit board means 32 has two end quarter λ printed circuit board radiating elements 76, 78 collinearly arranged on one side 34(b) of the double-sided board 34 with respect to the corresponding one half λ printed circuit board radiating element 56, 58, 60, 62, 64, 66, 68, 70, 72, 74. The two end quarter λ printed circuit board radiating elements 76, 78 are respectively soft soldered to corresponding one half λ printed circuit board radiating elements 36, 54 through one aperture (not shown) and a corresponding aperture 80 shown in Figure 2(b).

As shown in Figure 2(a) and 2(b), the overall length of the collinear microstrip printed circuit board means 32 is 34.4, the location of each short hole is 1.007 inches, the thickness of the exposed dielectric is 0.093 inches, the width of the collinear microstrip printed circuit board means 32 is 0.725 inches, the edge-to-center dimension is 0.362 inches, and each of the short holes has a diameter of 0.036 inches. Any person skilled in the microstrip antenna art would appreciate that the dimension of the printed circuit board radiating elements and the section of section of microstrip transmission lines depend on a number of parameters, including the wavelength, and are determined using equations set forth in Antenna Engineering Handbook, 3rd Edition, by Richard C. Johnson (1993), hereby incorporated by reference. See in particular Table 42-2 and Figure 42-4. See also "Linearly Polarized Microstrip Antennas", by Anders G. Derneryd, IEEE Transactions on Antennas and Propagation (November 1976), also hereby incorporated by reference. The scope of the invention is not intended to be limited to any particular dimension of the antenna, the printed circuit board radiating elements or the section of section of microstrip transmission lines.

As shown in Figure 3, the cable connector assembly means includes a connector 82, an inner insulated conductor member 83, and a cable adapter subassembly 84 arranged within the connector 82. As shown, the inner insulated conductor member 83 has a bend of 0.062 inches and the overall length after bending of the inner insulated conductor member conductor 83. The inner insulated conductor member 83 is soft soldered to a mid-

point of the collinear microstrip printed circuit board means 32 at a section of microstrip transmission line referred to 36(a) in Figure 1(a), as described below with respect to Figure 7.

Figure 4, including Figures 4(a)-(d), shows the connector 82 having a connector body 86, a first insulator 88, a pin 90, a second insulator 92 and a backing nut 94.

Figure 5 shows the cable adapter subassembly having an outer conductor adaptor 100, end conductor 101, and a cable stripping 102 arranged therein with a soft solder 104. When assembled, the end conductor 101 is joined to pin 90 in Figure 4(c) and has a dimension of 0.250 inches, as shown.

Figure 6 shows the outer conductor adaptor 100 having an outer conductor adaptor body 106 with first and second countersunk end openings 106(a) and (b). Figure 6(d) shows a cross-section of the outer conductor adaptor body 106 along lines Z-Z'. Figure 6 also shows the various dimensions of one embodiment of the outer conductor adaptor body 106.

Figure 7 shows the cable stripping 102 having an outer metallic sheathing 108 and the inner insulated conductor member 83, which includes an cable insulation means 110 arranged therein, and an inner conducting wire 112 arranged within the insulation means 110. The inner conductor 86 in Figure 3 includes the cable insulation means 110 and the inner conducting wire 112. As shown, the cable stripping is respectively 0.250 and 0.344 inches, and the length of the outer conductor is 21.00 inches.

As best shown in Figures 1 and 2, the outer metallic sheathing 108 is soft soldered along the entire edge joining the cable stripping 102 to a part of the section of the microstrip transmission lines referred to in Figure 2(a) as 66(a), 68(a), 70(a), 72(a), 74(a) arranged on the other side 34(a) of the double-sided board 34 opposite each corresponding one half λ printed circuit board radiating element 56, 66, 68, 70, 72, 74. In addition, the inner conducting wire 112 is soldered at a midpoint of the part of the section of the microstrip transmission lines referred to in Figure 2(a) as 64(a).

Figure 8 shows a potting assembly generally indicated as 113 that includes a support 114, and a radome 116 affixed by epoxy 118 therein. As shown, the overall length of the antenna without the cap is 38.188 inches.

Figure 9 shows the support 114 in greater detail, including helical grooves 115 and a moisture releasing aperture 114(a) best shown in Figure 9(c) which allows the antenna to be mounted both vertically and horizontally. Figure 9 also show various other dimensions used to design the support 114.

Figure 10 shows a complete assembly of the microstrip collinear antenna, having the potting assembly 113, the radome 116 affixed therein by epoxy 122, a radome top 123 affixed to the radome 116 by epoxy 124.

Figure 11 shows the radome 116 in greater detail having a length L equal to 36 13/16 inches, an outside diameter of 1 inch, and a wall diameter of 1/8 inch.

Figure 12, including Figures 12(a) and 12(b), shows in greater detail the radome top 120 having a radome moisture releasing aperture 122.

In operation, a radio frequency (RF) signal is carried to the midpoint of the collinear array of radiating elements by a cable running from the bottom. The RF signal then spreads along the antenna and propagates out away from all the radiating elements in phase. The radiating elements are close spaced and on both sides of the circuit board for a high gain omnidirectional system of radiators operating in unison. In comparison, in other types antennas having linear arrays on circuit boards, one side of the circuit board would serve as a ground plate, the other side could contain a microstrip line and radiators.

Figure 13 shows a polar dB plot at 1.99 GHz for the microstrip collinear antenna of the present invention having a zero dB circle of 15.85 dB, a beam peak of -89.80 degrees, a beamwidth of 8.66 degrees, and sidelobes of -104.75 degrees, -11.02 dB and 89.50 degrees, -0.32 dB.

Figure 14 shows a polar dB plot at 1.92 GHz for the microstrip collinear antenna of the present invention having a zero dB circle of 15.55 dB, a beam peak of -90.76 degrees, a beamwidth of 10.57 degrees, and sidelobes of -119.25 degrees, -16.18 dB and 90.25 degrees, -0.06 dB.

Figure 15 shows a polar dB plot at 1.85 GHz for the microstrip collinear antenna of the present invention having a zero dB circle of 15.53 dB, a beam peak of -90.85 degrees, a beamwidth of 8.58 degrees, and sidelobes of -106.50 degrees, -10.88 dB and 90.50 degrees, -1.51 dB.

The polar dB plots in Figures 13-15 indicate that the antenna of the present invention provides beam peaks having a location substantially at the 90 degrees horizon line.

Figure 16 shows a polar dB plot at 1.99 GHz for the prior art antenna having a beam peak of -88.34 degrees, a beamwidth of 12.06 degrees, and sidelobes of -87.00 degrees, -0.14 dB and 108.00 degrees, -10.63 dB.

Figure 17 shows a polar dB plot at 1.92 GHz for the prior art antenna having a beam peak of -91.63 degrees, a beamwidth of 13.92 degrees, and sidelobes of -114.75 degrees, -10.55 dB and 91.50 degrees, -0.82 dB.

Figure 18 shows a polar dB plot at 1.85 GHz for the prior art antenna having a beam peak of -95.08 degrees, a beamwidth of 12.95 degrees, and sidelobes of -95.50 degrees, -0.21 dB and 116.75 degrees, -10.16 dB.

The polar dB plots in Figures 16-18 indicate that the antenna of the prior art provide a beam peak having a location deviating about 2-3 degrees from the horizon line.

Although the present invention has been described and discussed herein with respect to at least one embodiment, other arrangements or configurations may also be used that do not depart from the spirit and scope hereof. For example, the invention is shown and de-

scribed with various dimensions which are provided as an example of one embodiment. The scope of the invention is not intended to be limited to any such dimensions.

Claims

1. An antenna (20), comprising:

   cable connector assembly means (30), responsive to a radio signal, for providing a cable connector assembly radio signal; and
   a collinear microstrip printed circuit board means (32), responsive the cable connector assembly radio signal, for providing a collinear microstrip printed circuit board radio signal.

2. An antenna (20) according to claim 1, wherein the collinear microstrip printed circuit board means (30) further comprises:

   a double sided circuit board (34);
   a plurality of one half λ printed circuit board radiating elements (36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74) collinearly arranged on each side of the double-sided board; and
   a respective section of microstrip transmission lines (36(a), 38(a), 40(a), 42(a), 44(a), 46(a), 48(a), 50(a), 52(a), 54(a), 56(a), 58(a), 60(a), 62(a), 64(a), 66(a), 68(a), 70(a), 72(a), 74(a)) arranged on the other side of the double-sided circuit board (34) opposite each corresponding one half λ printed circuit board radiating element (36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74).

3. An antenna (20) according to claim 1, wherein the cable connector assembly means (30) includes a connector (82), and a cable adapter subassembly (84) arranged within said connector (82).

4. An antenna (20) according to claim 3, wherein the connector (82) includes a connector body (86), a first insulator (88), a pin (90), a second insulator (92) and a backing nut (94).

5. An antenna (20) according to claim 3, wherein the cable adapter subassembly (84) includes an outer conductor adaptor (100), and a cable stripping (102) arranged therein with a soft solder (104).

6. An antenna (20) according to claim 5, wherein the outer conductor adaptor (100) includes an outer conductor adaptor body (106) having first and second countersunk end openings (106(a), 106(b).

7. An antenna (20) according to claim 3, wherein the cable stripping (102) includes an outer metallic sheathing (108), an insulation means (110) arranged therein; and an inner conducting wire (112) arranged within the insulation means (110).

8. An antenna (20) according to claim 1, wherein the antenna (20) further comprises:

   a support (114) having apertures (114(a)) therein for protecting the collinear microstrip printed circuit board means (30); and
   a radome (116) having an aperture (122) affixed thereon.

9. An antenna (20) according to claim 2, wherein the cable connector assembly means (30) includes a connector (82), and a cable adapter subassembly (84) arranged within said connector (82).

10. An antenna (20) according to claim 9, wherein the cable adapter subassembly includes an outer conductor adaptor (100), and a cable stripping (102) arranged therein with a soft solder (104).

11. An antenna (20) according to claim 10, wherein the cable stripping (102) includes an outer metallic sheathing (108), an insulation means (110) arranged therein; and an inner conducting wire (112) arranged within the insulation means (110).

12. An antenna (20) according to claim 11, wherein the outer metallic sheathing (108) is soft soldered along an entire edge joining the cable stripping (102) to a part of the section of the microstrip transmission lines (36(a), 38(a), 40(a), 42(a), 44(a), 46(a), 48(a), 50(a), 52(a), 54(a), 56(a), 58(a), 60(a), 62(a), 64(a), 66(a), 68(a), 70(a), 72(a), 74(a)) arranged on the other side of the double-sided circuit board (34) opposite each corresponding one half λ printed circuit board radiating element (36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74).

13. An antenna (20) according to claim 11, wherein the inner conducting wire (12) is soldered at a midpoint of a part of the section of the microstrip transmission line (64(a)).

14. An antenna (20) according to claim 11, wherein the antenna (20) is a personal service communication antenna.

15. An antenna (20) according to claim 1, wherein the antenna (20) is a personal service communication antenna.

16. An antenna (20) according to claim 2, wherein the collinear microstrip printed circuit board means (32)

has two end quarter λ printed circuit board radiating elements (76, 78) collinearly arranged on one side of the double-sided circuit board (34) 34 with respect to the corresponding one half λ printed circuit board radiating element (36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74).

17. An antenna (20) according to claim 16, wherein the two end quarter λ printed circuit board radiating elements (76, 78) are respectively soft soldered to corresponding one half λ printed circuit board radiating elements (36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74).

18. A personal service communication antenna (20), comprising:

cable connector assembly means (30), responsive to a radio signal, for providing a cable connector assembly radio signal;
a collinear microstrip printed circuit board means (32), responsive the cable connector assembly radio signal, for providing a collinear microstrip printed circuit board radio signal;
said collinear microstrip printed circuit board means (32) comprising: a double sided circuit board (34), a plurality of one half λ printed circuit board radiating elements (36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74) collinearly arranged on a side of the double-sided board, and a respective section of microstrip transmission lines (36(a), 38 (a), 40(a), 42(a), 44(a), 46(a), 48(a), 50(a), 52 (a), 54(a), 56(a), 58(a), 60(a), 62(a), 64(a), 66 (a), 68(a), 70(a), 72(a), 74(a)) arranged on an opposing side of the double-sided circuit board (34) in relation to each corresponding one half λ printed circuit board radiating element (36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74);
the cable connector assembly means (30) including a connector (82), and a cable adapter subassembly (84) arranged within the connector (82);
the cable adapter subassembly (84) including an outer conductor adaptor(100), and a cable stripping (102) arranged therein with a soft solder, the cable stripping (102) including an outer metallic sheathing (108), an insulation means (110) arranged therein, and an inner conducting wire (112) arranged within the insulation means (110);
the outer metallic sheathing (108) being soft soldered along an entire edge joining the cable stripping (102) to a part of the section of the microstrip transmission lines (66(a), 68(a), 70 (a), 72(a), 74(a)) and the corresponding one half λ printed circuit board radiating element (46, 48, 50, 52); and
the inner conducting wire (112) being soldered to a midpoint of the part of the section of the microstrip transmission line (64(a)).

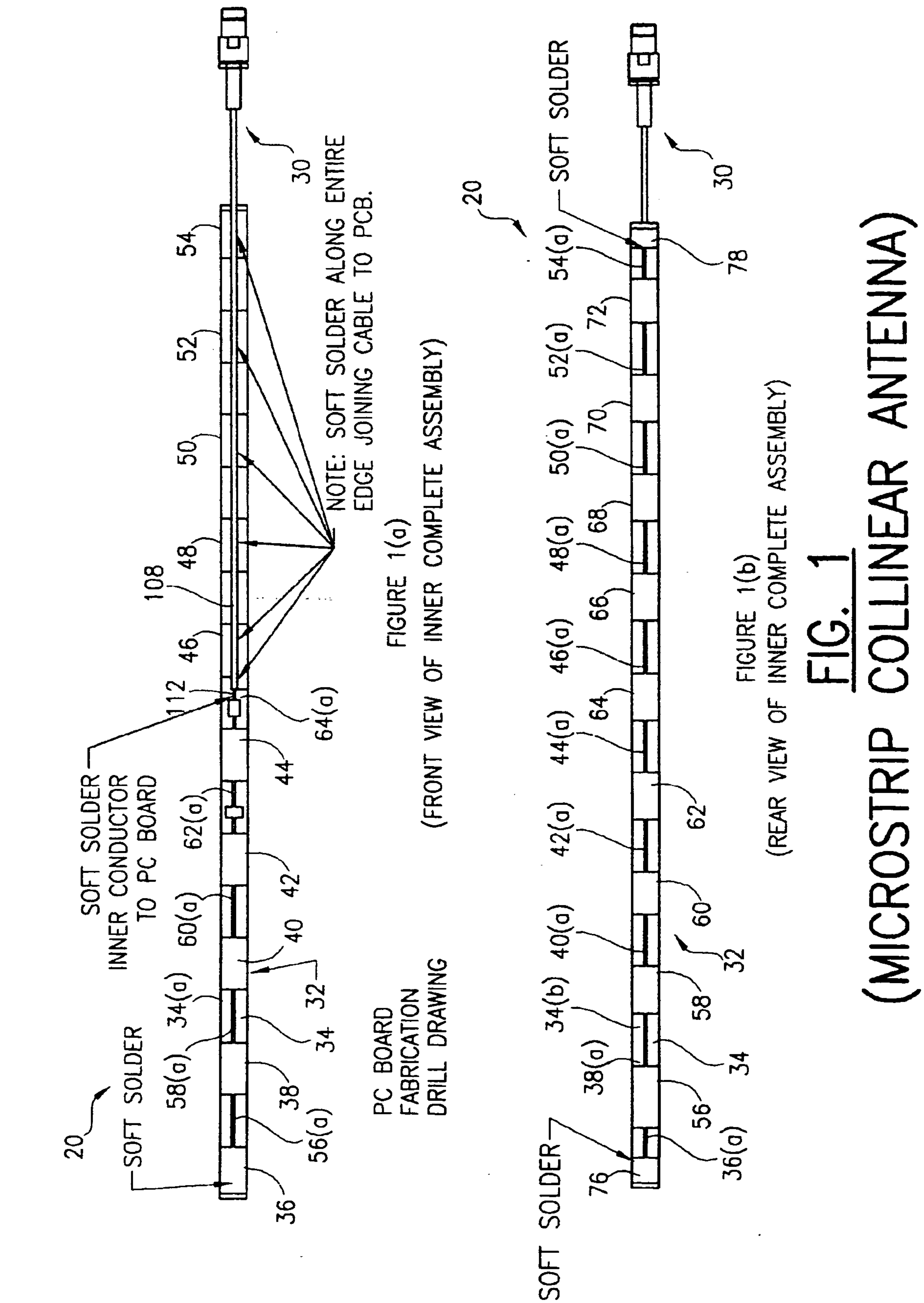


FIG. 1
(MICROSTRIP COLLINEAR ANTENNA)

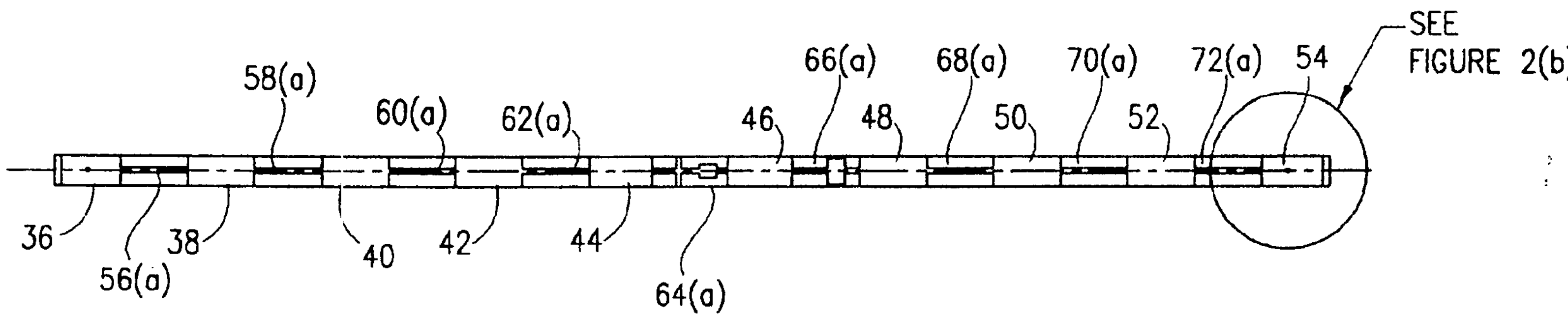


FIGURE 2(a)

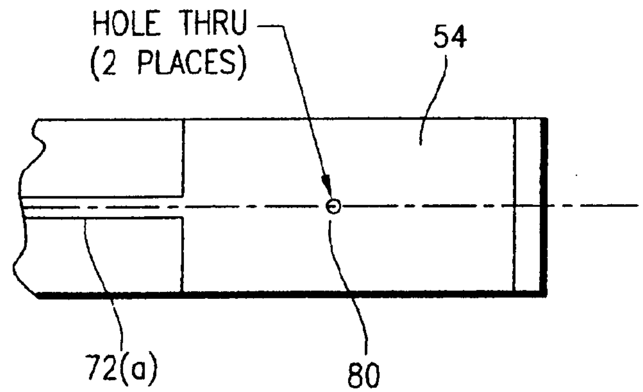


FIGURE 2(b)

FIG. 2

(PC BOARD FABRICATION DRILL DRAWING)

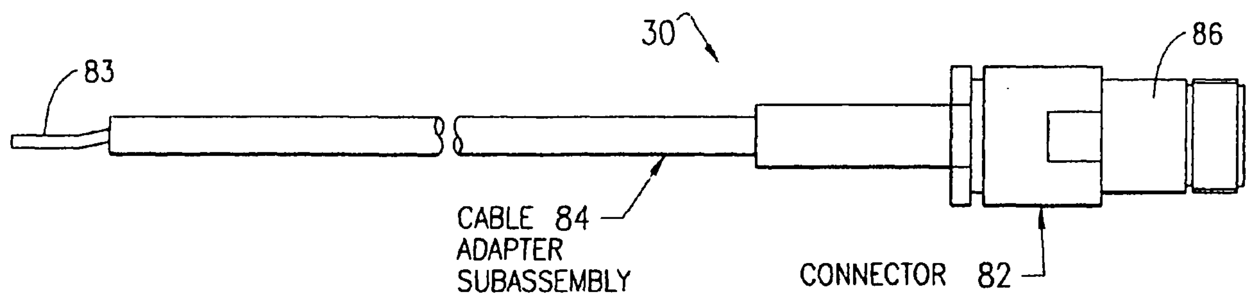
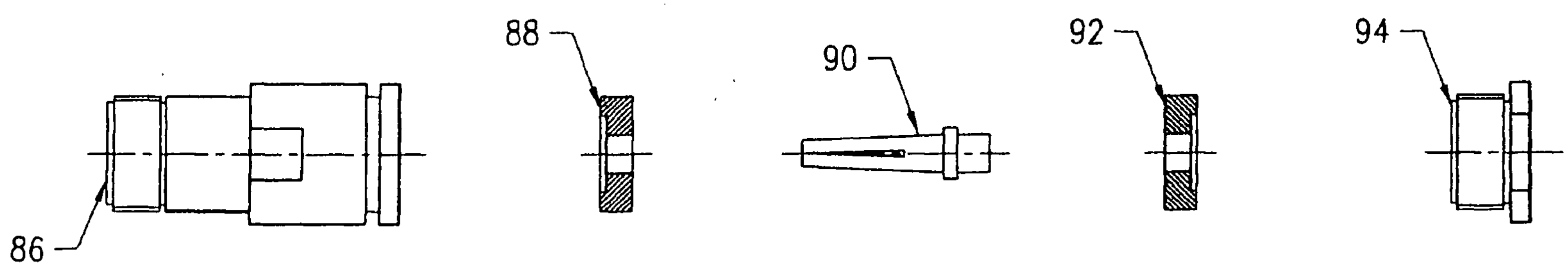


FIG. 3
(CABLE CONNECTOR ASSEMBLY)



(CONNECTOR BODY) SILVER PLATE
FIG. 4(a)

INSULATOR
FIG. 4(b)

PIN
FIG. 4(c)

INSULATOR
FIG. 4(d)

(BACKING NUT) SILVER PLATE
FIG. 4(e)

FIG. 4
(CONNECTOR)

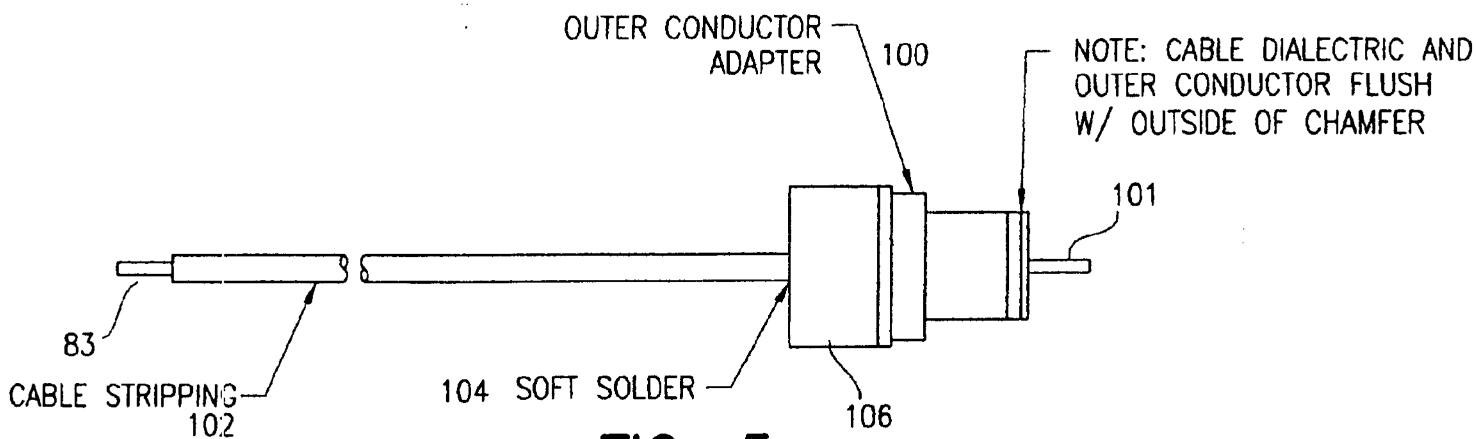


FIG. 5
(CABLE ADAPTER SUBASSEMBLY)

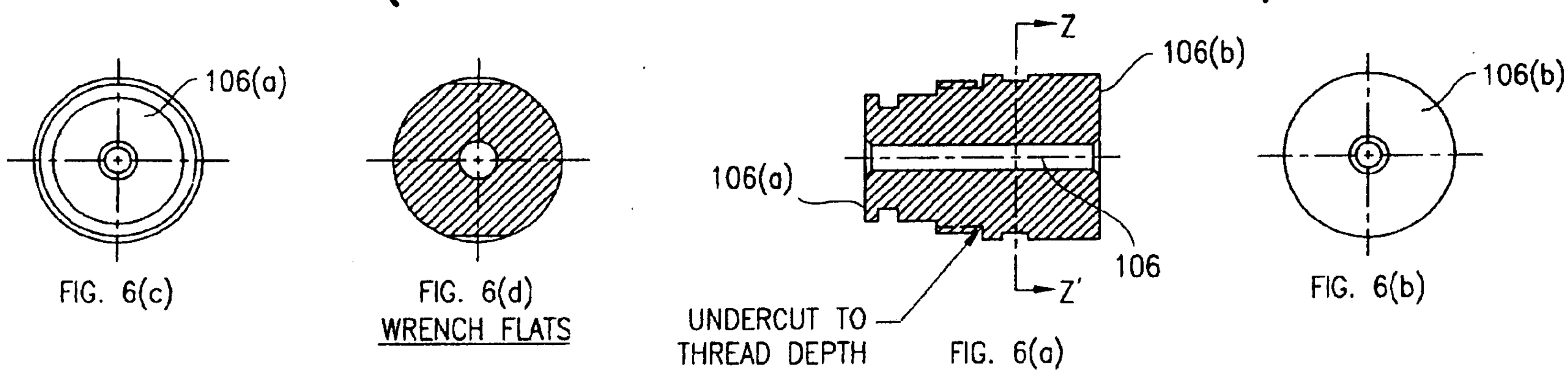


FIG. 6
(OUTER CONDUCTOR ADAPTER)

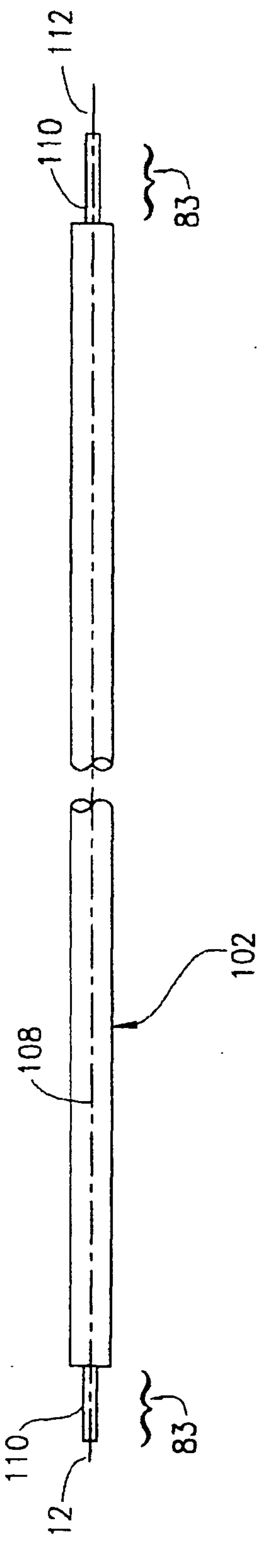


FIG. 7
(CABLE STRIPPING)

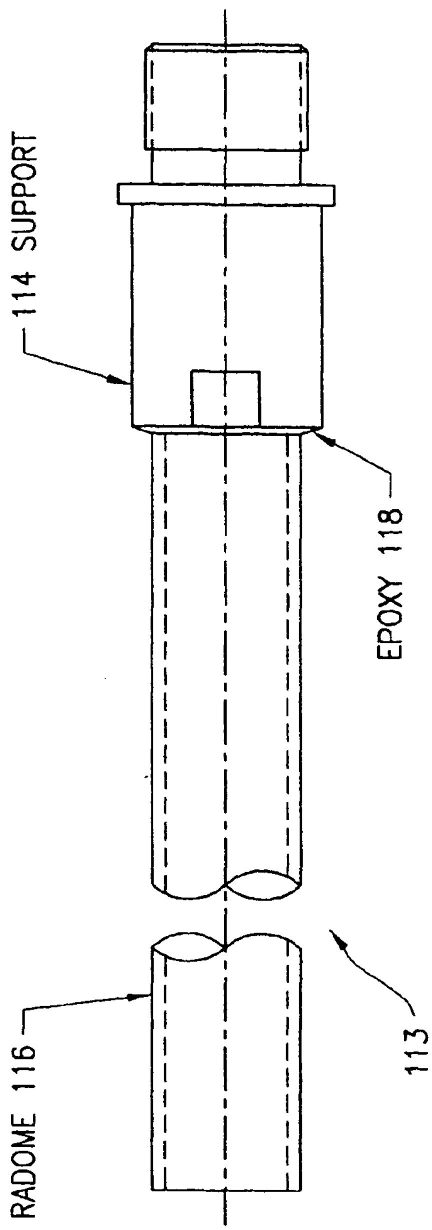


FIG. 8
(POTTING ASSEMBLY)

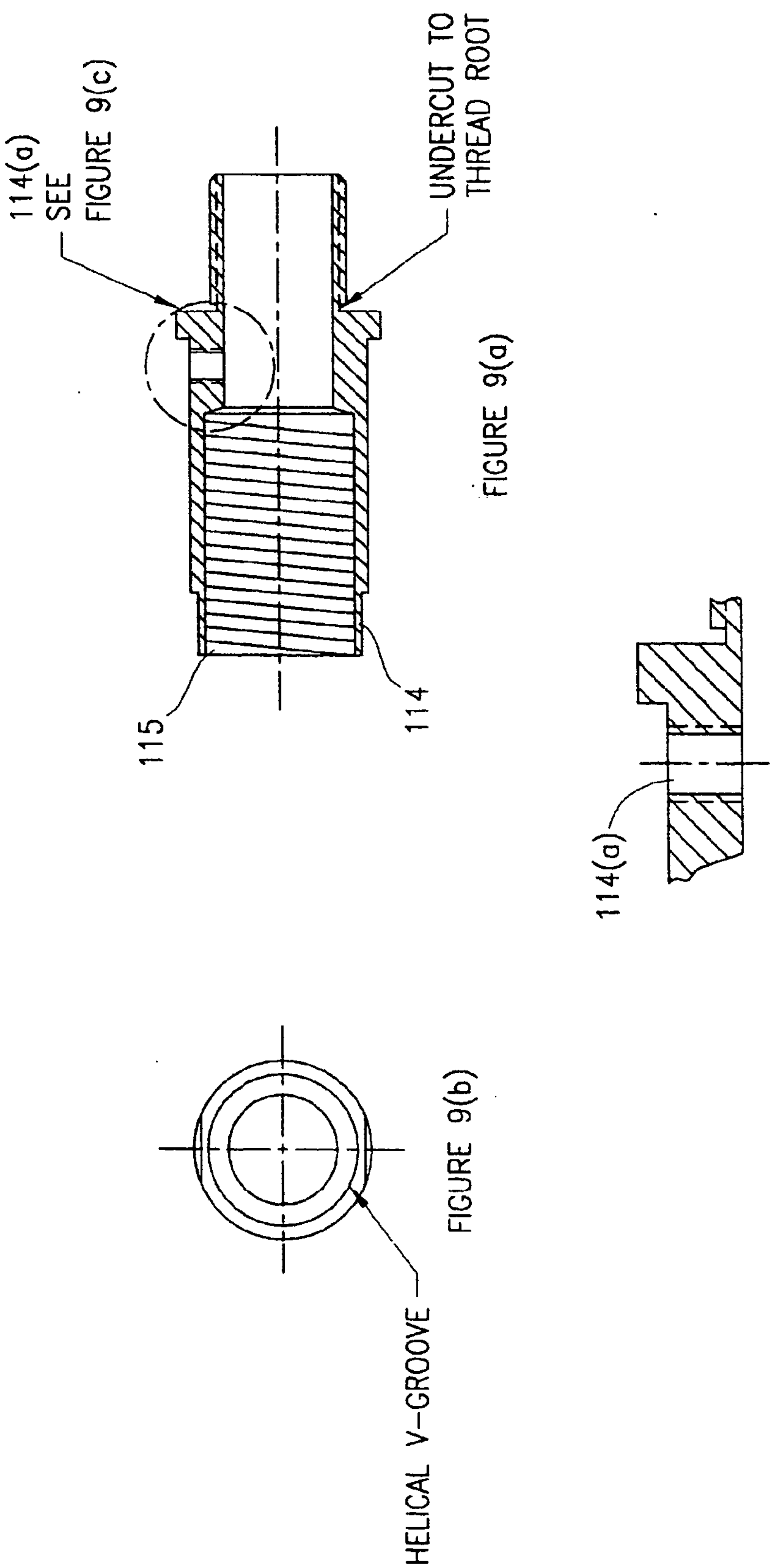


FIGURE 9(a)

FIGURE 9(c)

FIGURE 9(b)

FIG. 9
(SUPPORT)

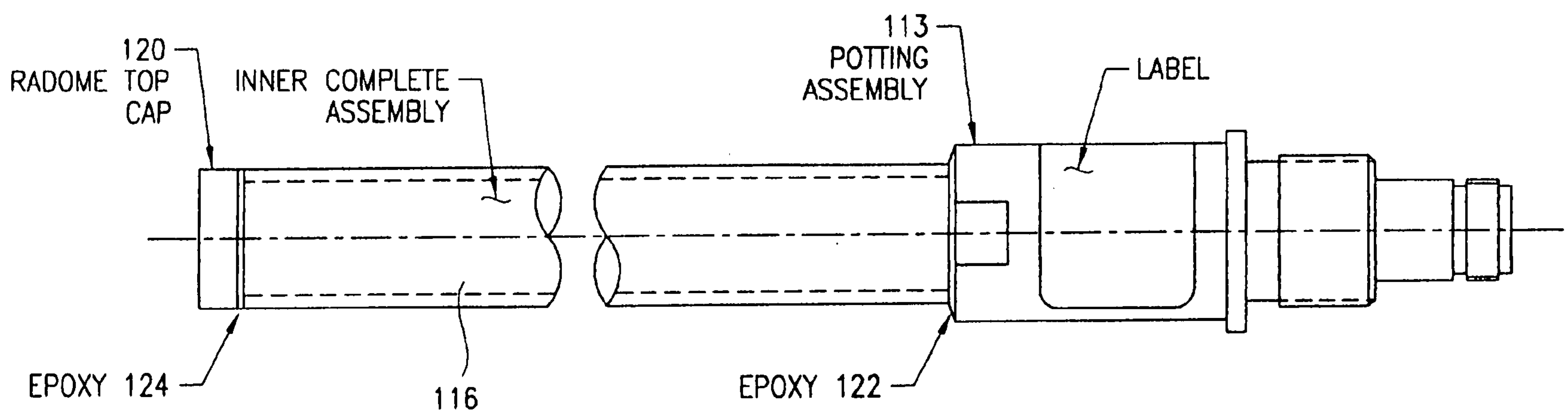


FIG. 10
(COMPLETE ASSEMBLY)

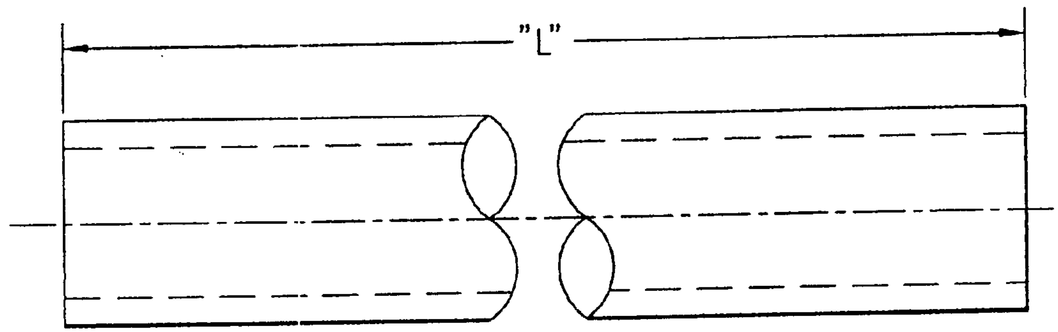


FIG. 11(a)

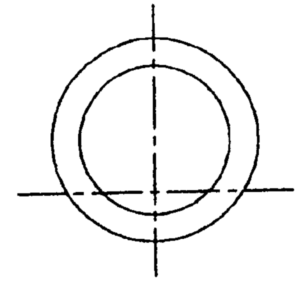
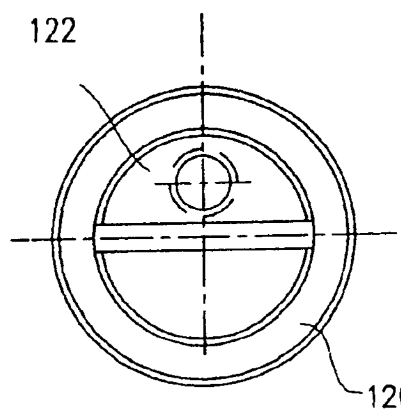


FIG. 11(b)

FIG. 11
(RADOME)



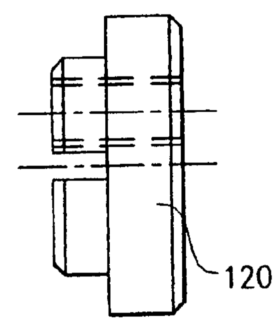
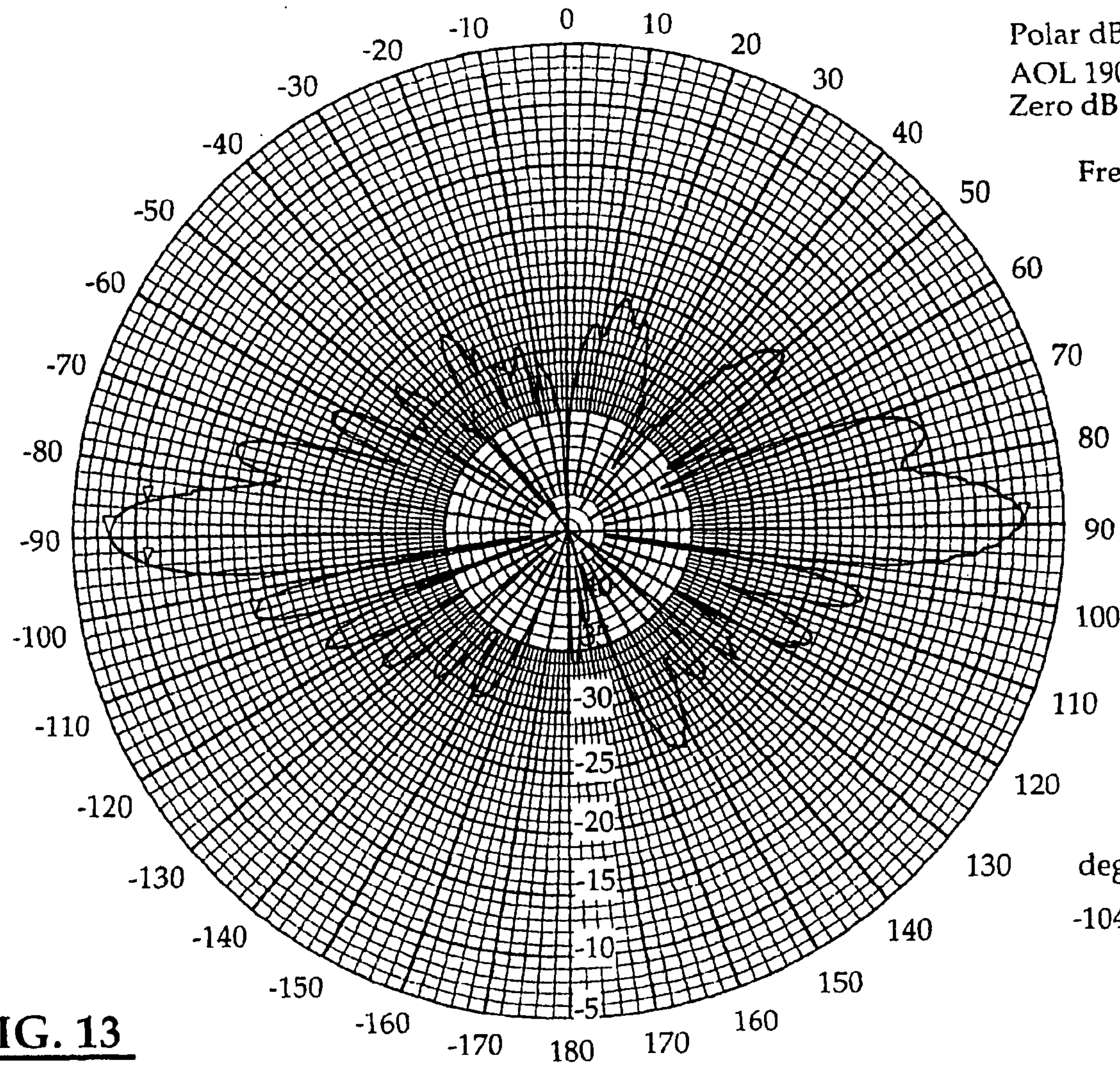


FIG. 12
(RADOME TOP CAP)



Polar dB
AOL 1906
Zero dB Circle is 15.85dBi @ 1.99 GHz

Freq: 1.990 GHz

Beam Peak -89.80 deg

Beamwidth 8.66 deg

Sidelobes

degree	dB	degree	dB
-104.75	-11.02	89.50	-0.32

FIG. 13

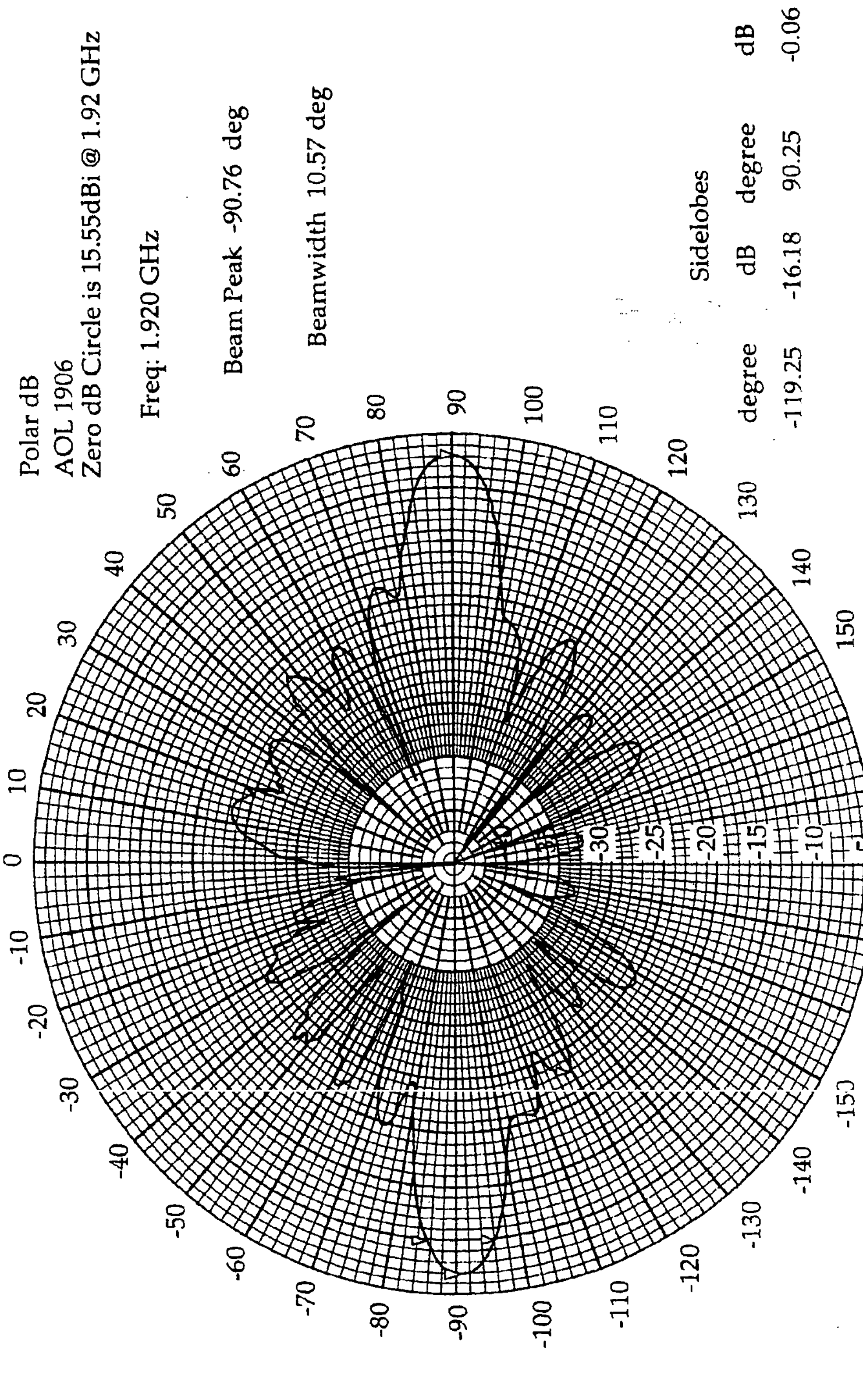
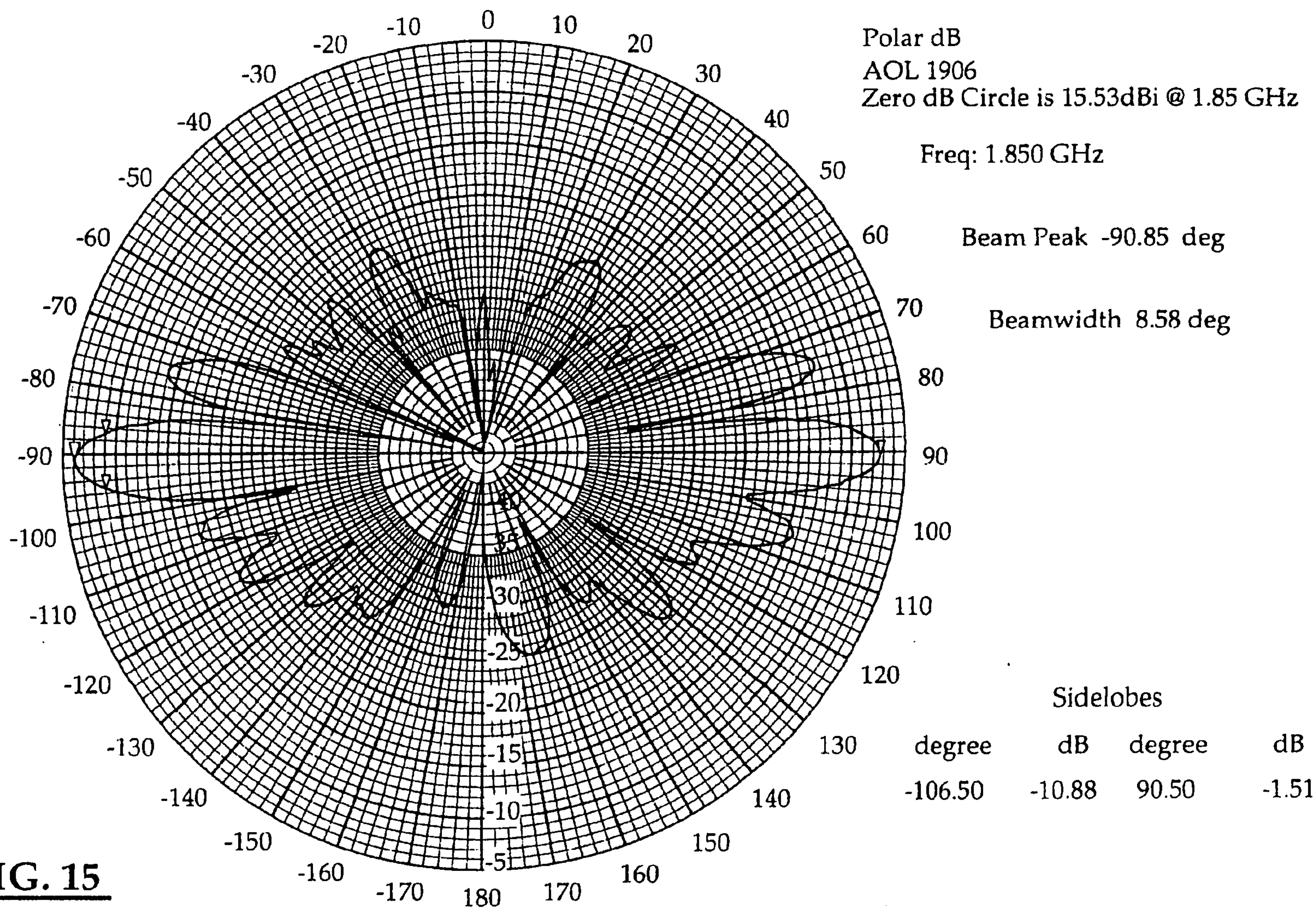

Polar dB
AOL 1906
Zero dB Circle is 15.55dBi @ 1.92 GHz
Freq: 1.920 GHz
Beam Peak -90.76 deg
Beamwidth 10.57 deg
Sidelobes
degree dB degree dB
-119.25 -16.18 90.25 -0.06
-30 -25 -20 -15 -10 -5

FIG. 14


0
10
20
30
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60
70
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90
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120
130
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180
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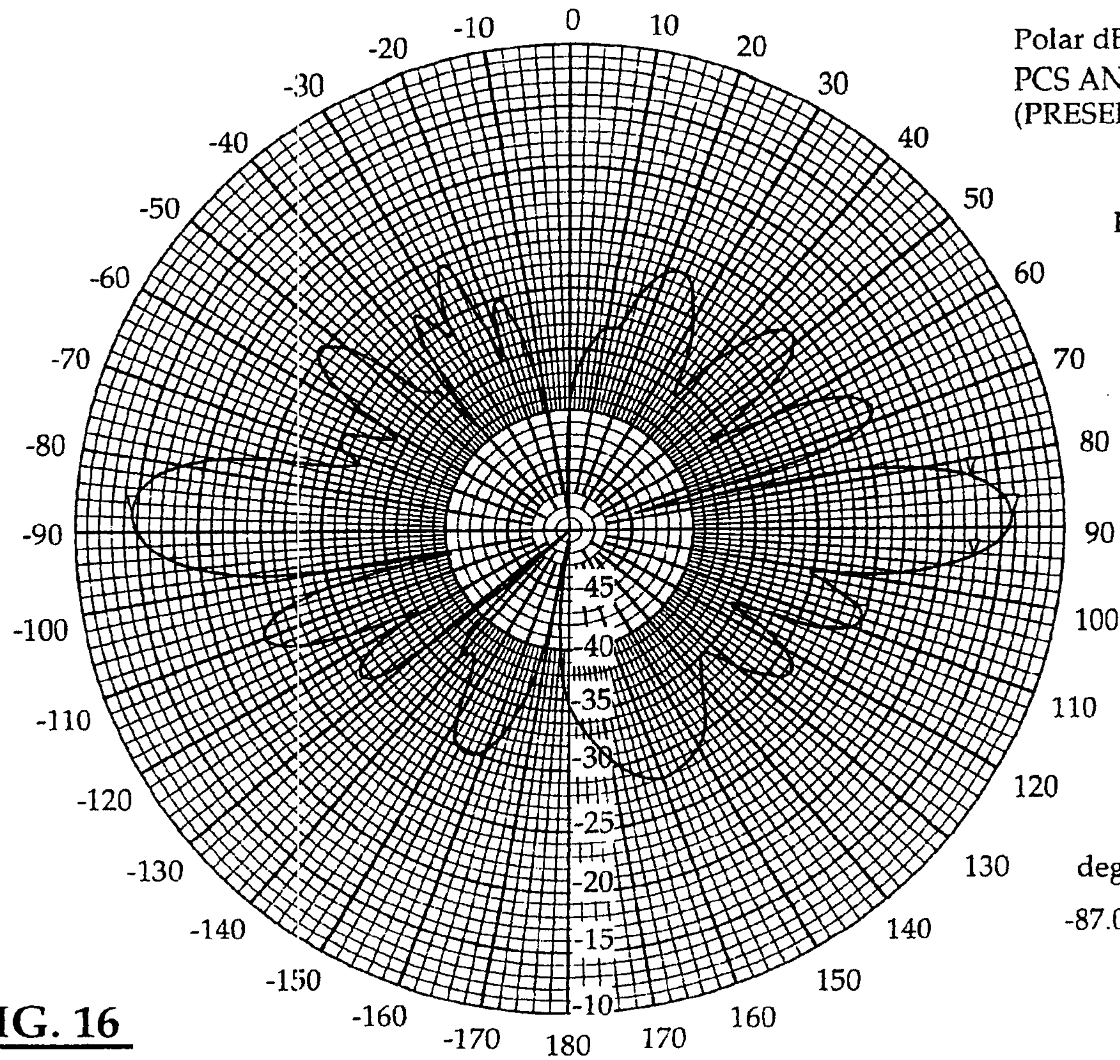
-150
-140
-130
-120
-110
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
-40
-35
-30
-25
-20
-15
-10
-5
Polar dB
AOL 1906
Zero dB Circle is 15.53dBi @ 1.85 GHz
Freq: 1.850 GHz
Beam Peak -90.85 deg
Beamwidth 8.58 deg
Sidelobes
degree dB degree dB
-106.50 -10.88 90.50 -1.51

FIG. 15



Polar dB
PCS ANTENNA
(PRESENT OMNI PRIOR ART)

Freq: 1.990 GHz

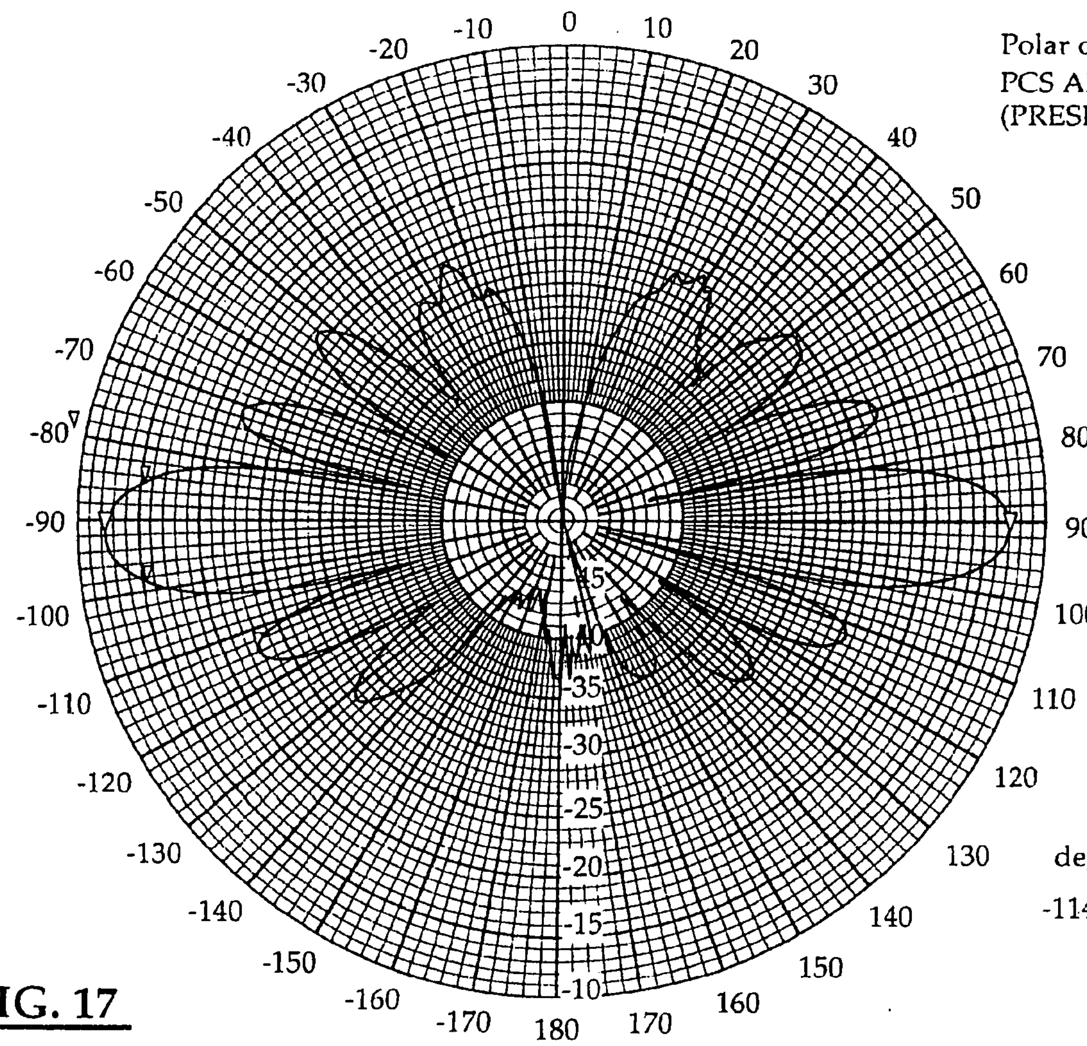
Beam Peak 88.34 deg

Beamwidth 12.06 deg

Sidelobes

degree	dB	degree	dB
-87.00	-0.14	108.00	-10.63

FIG. 16



Polar dB
PCS ANTENNA
(PRESENT OMNI PRIOR ART)

Freq: 1.920 GHz

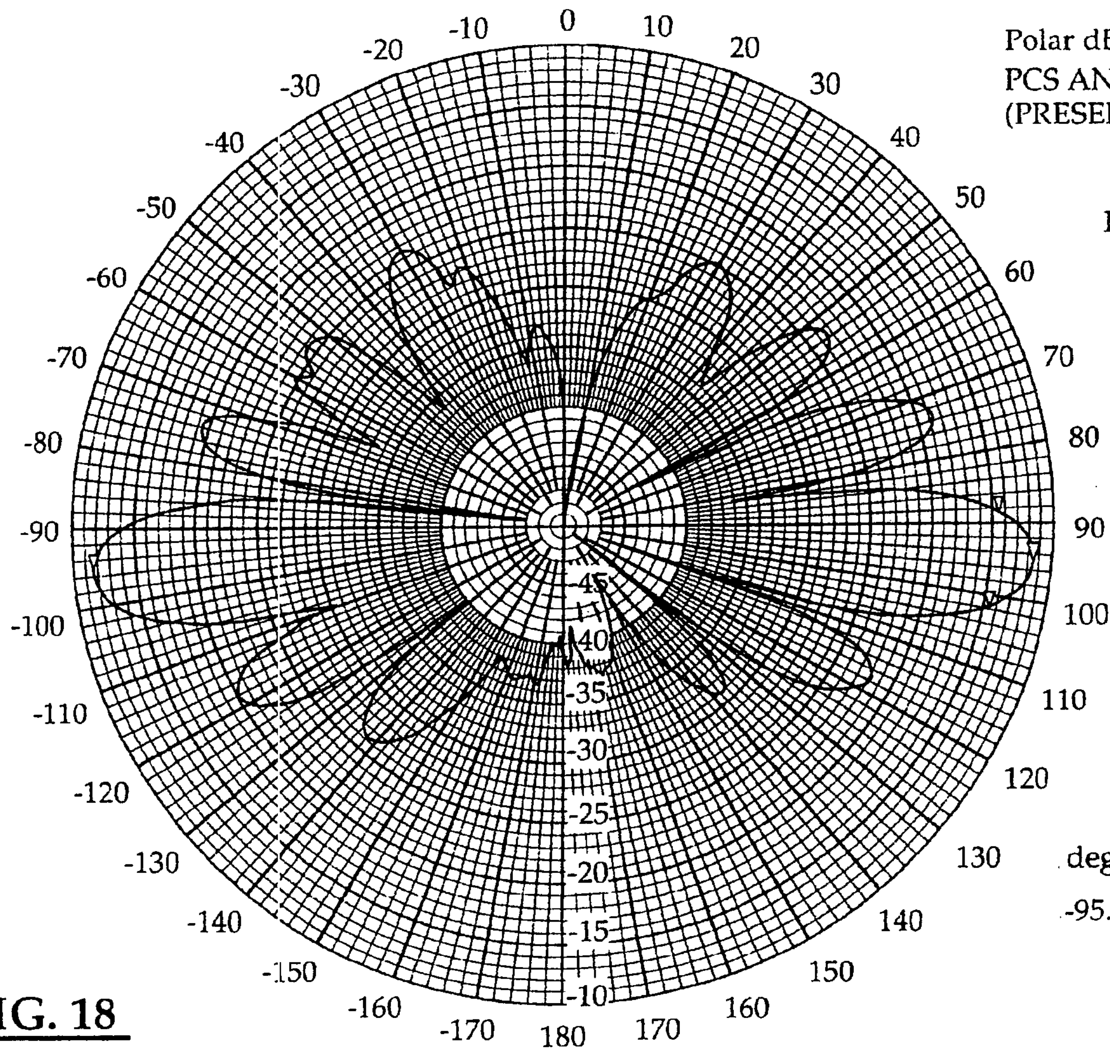
Beam Peak -91.63 deg

Beamwidth 13.92 deg

Sidelobes

degree	dB	degree	dB
-114.75	-10.55	91.50	-0.82

FIG. 17



Polar dB
PCS ANTENNA
(PRESENT OMNI PRIOR ART)

Freq: 1.850 GHz

Beam Peak 95.08 deg

Beamwidth 12.95 deg

Sidelobes

degree	dB	degree	dB
-95.50	-0.21	116.75	-10.16

FIG. 18

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(54) Microstrip collinear antenna

(57) The present invention provides a microstrip collinear antenna (20) having cable connector assembly means (30) and a collinear microstrip printed circuit board means (32). The cable connector assembly means (20) responds to a radio signal, for providing a cable connector assembly radio signal. The collinear microstrip printed circuit board means (32) responds to the cable connector assembly radio signal, for providing a collinear microstrip printed circuit board radio signal. The microstrip line collinear antenna (20) is constructed with a number of one half λ printed circuit board elements on both sides [34(a),34(b)] of a double-sided board (34). These one half λ sections are the radiators. On the other side of the board opposite each radiator [36,38,...,54;56,58,...,72] is a respective section of corresponding microstrip transmission lines [36(a),38(a),...,54(a);56(a),58(a),...,72(a)] to provide radio frequency power to each radiating element. The microstrip line collinear antenna (20) has the following advantages over the prior art antennas: it achieves shorter length due to close physical spacing of radiators, it maintains consistent pattern and impedance performance across the operating frequency range, it allows for accurate and consistent manufacturing through the use of advanced printed circuit board materials, allows for center feed design to achieve high-gain broadband operation, and it allows cost reduction with printed circuit board materials.

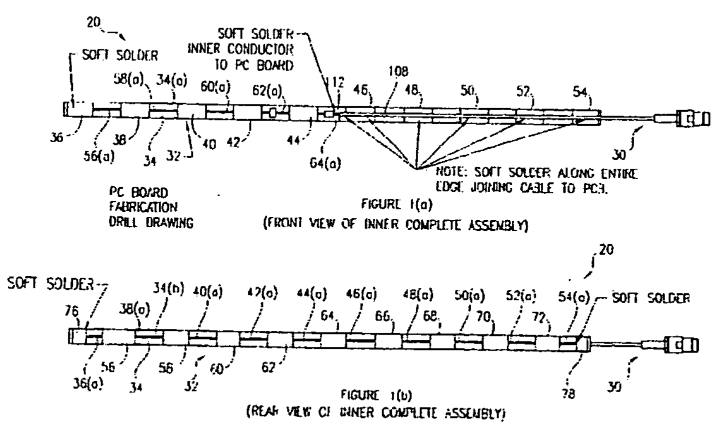

FIG. 1
(MICROSTRIP COLLINEAR ANTENNA)

EP 0 855 760 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 40 0127

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 487 053 A (ANDREW CORP) 27 May 1992 * column 3, line 13 - column 6, line 31; figures 1,2,6-8 * * abstract *	1-18	H01Q21/10
A	DE 43 08 604 A (KOLBE & CO HANS) 22 September 1994 * abstract; figures 1,2 *	1,18	
A	WO 96 38882 A (ERICSSON GE MOBILE INC) 5 December 1996 * abstract; figures 1,2 *	1,18	
D,A	US 3 031 668 A (BRYSON W.B) 24 April 1962 * column 2, line 25 - column 3, line 29; figures 1,1A,2 *	1-3, 5-12, 14-18	
A	US 3 995 277 A (OLYPHANT JR MURRAY) 30 November 1976 * abstract; figures 1,2 *	1,18	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	US 5 589 843 A (MEREDITH SHELDON K ET AL) 31 December 1996 * abstract; figures 3,6,10 *	1,18	H01Q
A	DE 42 25 298 A (KOLBE & CO HANS) 3 February 1994 * abstract; figure 4 *	1,18	
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 010, 31 October 1996 & JP 08 148931 A (TECH RES &DEV INST OF JAPAN DEF AGENCY; NEC CORP), 7 June 1996, * abstract *	1,3-7, 9-12,18	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	20 May 1998	Felgel-Farnholz, W-D

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